

**UNIVERSAL WINDOW TIMES  
JULY 1976 thru DECEMBER 1977**

**AN HP2000C BASIC COMPUTER  
PROGRAM FOR MOON TRACKING**



**DIVISION OF VARIAN  
301 Industrial Way  
San Carlos, California**

The following Universal Window times are based on the new specifications outlined in AS-49-12. The moon is always at a north, or positive, declination during the European Universal Window. The start of the window is two hours from the setting moon time in Frankfurt, Germany. The end of the window is when the moon sets at this same location. The level of activity in any of the windows will depend upon how reasonable the time of the day is. Early hours in the morning on working days will not be too attractive to many operators. The last hour of the window will be the most popular time for those stations with antennas pointing toward the horizon.

The times were calculated in two minute increments; therefore, there can be up to a plus or minus two minute error.

Also included are the times each month for the new moon. During the summer months the moon and sun appear to be in the same place in the sky. The sun noise can therefore mask any moonbounce signals. At least one day can be lost, and perhaps more, depending upon the directivity of the antenna arrays at both ends of the path.

## JULY-1976

Day	GMT
1	1924-2123
2	1950-2149
16	0708-0909
17	0813-1014
18	0917-1116
19	1019-1217
20	1118-1319
21	1218-1417
22	1314-1514
23	1408-1606
24	1458-1657
25	1544-1742
26	1623-1822
27	1659-1855
28	1729-1925
29	1755-1953

## AUGUST-1976

Day	GMT
13	0558-0758
14	0703-0903
15	0805-1005
16	0906-1106
17	1007-1204
18	1103-1302
19	1157-1356
20	1249-1447
21	1336-1532
22	1418-1616
23	1454-1653
24	1527-1726
25	1557-1755

## SEPTEMBER-1976

Day	GMT
9	0344-0546
10	0448-0649
11	0553-0753
12	0655-0855
13	0755-0955
14	0853-1051
15	0947-1147
16	1038-1238
17	1127-1324
18	1210-1408
19	1248-1445
20	1323-1521
21	1353-1551
22	1421-1619

## OCTOBER-1976

Day	GMT
7	0238-0441
8	0343-0544
9	0444-0644
10	0546-0746
11	0644-0844
12	0740-0938
13	0833-1030
14	0921-1120
15	1004-1203
16	1044-1242
17	1119-1317
18	1150-1348
19	1220-1418
20	1246-1446

## NOVEMBER-1976

Day	GMT
3	0031-0233
4	0135-0335
5	0237-0437
6	0338-0537
7	0438-0638
8	0534-0734
9	0629-0827
10	0719-0915
11	0804-1002
12	0844-1042
13	0920-1118
14	0952-1148
15	1020-1218
16	1046-1244
29-30	2222-0022
30-1	2327-0127

## DECEMBER-1976

Day	GMT
2	0029-0229
3	0131-0331
4	0231-0429
5	0329-0527
6	0424-0621
7	0516-0714
8	0602-0800
9	0646-0842
10	0723-0921
11	0756-0952
12	0824-1022
13	0850-1048
27	2114-2314
28-29	2218-0018
29-30	2320-0120
31	0020-0220

## JANUARY-1977

Day	GMT
1	0119-0319
2	0216-0414
3	0308-0508
4	0359-0557
5	0444-0642
6	0523-0721
7	0559-0757
8	0629-0827
9	0657-0855
10	0722-0920
23	1855-2055
24	2001-2201
25	2105-2305
26-27	2206-0006
27-28	2306-0106
29	0004-0202
30	0059-0257
31	0149-0347

## FEBRUARY-1977

Day	GMT
1	0238-0434
2	0320-0518
3	0359-0555
4	0431-0629
5	0501-0659
6	0527-0725
20	1742-1944
21	1848-2050
22	1953-2151
23	2053-2253
24	2152-2351
25-26	2246-0045
26-27	2338-0138
28	0027-0225

## MARCH-1977

Day	GMT
1	0112-0310
2	0153-0349
3	0227-0425
4	0259-0457
5	0329-0527
19	1527-1729
20	1633-1835
21	1738-1938
22	1840-2040
23	1940-2140
24	2036-2236
25	2131-2329
26-27	2220-0018
27-28	2304-0102
28-29	2346-0144
30	0023-0221
31	0057-0253

## APRIL-1977

Day	GMT
1	0126-0324
2	0154-0352
16	1423-1623
17	1527-1727
18	1631-1831
19	1731-1931
20	1829-2027
21	1923-2123
22	2014-2212
23	2100-2258
24	2142-2340
25-26	2242-0018
26-27	2255-0051
27-28	2325-0122
28-29	2352-0151
30	0020-0218

## MAY-1977

Day	GMT
13	1216-1416
14	1320-1520
15	1422-1622
16	1523-1723
17	1623-1821
18	1719-1917
19	1812-2010
20	1859-2057
21	1942-2140
22	2021-2219
23	2055-2253
24	2127-2325
25	2154-2352
26-27	2220-0018

## JUNE-1977

Day	GMT
9	1015-1207
10	1111-1313
11	1214-1416
12	1316-1516
13	1416-1616
14	1512-1712
15	1606-1806
16	1657-1855
17	1742-1940
18	1823-2021
19	1859-2057
20	1931-2129
21	1959-2157
22	2025-2213

## JULY-1977

Day	GMT
7	0859-1059
8	1005-1205
9	1108-1308
10	1208-1406
11	1305-1505
12	1401-1559
13	1451-1651
14	1540-1738
15	1623-1821
16	1701-1859
17	1735-1933
18	1805-2003
19	1833-2029
20	1857-2055

## AUGUST-1977

Day	GMT
3	0640-0842
4	0748-0950
5	0855-1053
6	0957-1155
7	1055-1255
8	1151-1351
9	1244-1442
10	1334-1532
11	1419-1617
12	1459-1657
13	1535-1733
14	1607-1805
15	1637-1833
16	1703-1901
31	0529-0731

## SEPTEMBER-1977

Day	GMT
1	0636-0838
2	0742-0942
3	0844-1042
4	0942-1140
5	1036-1234
6	1127-1325
7	1212-1410
8	1255-1453
9	1333-1529
10	1405-1603
11	1437-1633
12	1504-1703
13	1531-1729
27	0312-0512
28	0420-0620
29	0527-0725
30	0629-0829

## OCTOBER-1977

Day	GMT
1	0729-0929
2	0825-1025
3	0918-1116
4	1006-1204
5	1049-1247
6	1129-1325
7	1203-1401
8	1235-1431
9	1303-1501
10	1331-1529
24	0059-0301
25	0207-0408
26	0314-0514
27	0418-0618
28	0518-0718
29	0616-0816
30	0710-0910
31	0801-0959

## NOVEMBER-1977

Day	GMT
1	0846-1044
2	0925-1123
3	1001-1159
4	1033-1231
5	1103-1301
6	1129-1327
7	1155-1353
21	0000-0201
22	0105-0305
23	0209-0409
24	0310-0510
25	0408-0608
26	0504-0702
27	0557-0753
28	0642-0840
29	0725-0923
30	0803-1001

## DECEMBER-1977

Day	GMT
1	0835-1033
2	0905-1103
3	0933-1129
4	0957-1155
18-19	2257-0057
20	0000-0201
21	0103-0303
22	0203-0401
23	0259-0457
24	0351-0549
25	0440-0638
26	0525-0723
27	0605-0803
28	0639-0837
29	0710-0908
30	0737-0935
31	0803-1001

<u>1976</u>	<u>Newmoon</u>	<u>Perigee</u>	<u>Apogee</u>
July	27	7	19
August	25	1, 28	16
September	23	25	12
October	23	23	10
November	21	21	6
December	21	19	3

1977

January	19	16	28
February	18	11	25
March	19	8-9	24
April	18	5	21
May	18	4	18
June	16	1, 29-30	14
July	16		12
August	14	28	9
September	13	24	5
October	12	18	3, 31
November	11	12	27
December	10	10	24

The HP2000C BASIC program (POEME) presented here is an outgrowth of a program written by Lance Collister, WB7CCI, using GE BASIC. A few things were added to help define the European, VE-W, and the JA-VK-ZL windows. In the sample printout included, the "U" printed after the declination column indicates the moon is in the European Universal Window. The "W" indicates the moon is in the VE-W window and "J" indicates the JA-VK-ZL window.

An ACS-3750 terminal was used to list the program. The circumflex (a little upside down v) indicates exponentiation. On a standard model 33 eight level teletype machine the equivalent is an up arrow obtained by a shift-N. Statements 1080 and 1410 are examples of where this difference must be considered. The sample printout was done on a model 33 teletype.

POEME

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10 DIM F[25],V[25],Y[25],Q[25],S[25]
20 DEF FNA(X)=INT(X*D5*10+.5)/10
30 DEF FNB(X)=(X-INT(X))*P5
40 LET P5=2*3.14159
50 LET D5=360/P5
60 LET R5=P5/360
70 DIM Z$(6)
80 PRINT "WHAT ARE THE STATION CALL LETTERS";
90 INPUT Z$
100 PRINT "WHAT IS YOUR LATITUDE IN DEGREES,MINUTES";
110 INPUT L5,U5
120 PRINT "WHAT IS YOUR LONGITUDE IN DEGREES,MINUTES";
130 INPUT L6,U6
140 LET L5=(L5+U5/60)*P5
150 LET L6=(L6+U6/60)*R5
160 PRINT "WHAT IS DESIRED PRINTING INCREMENT IN MINUTES";
170 INPUT I
180 PRINT "DO YOU ONLY WANT PRINTOUT WHEN THE MOON"
190 PRINT "IS NEAR THE HORIZON(1=YES,0=NO)";
200 INPUT Q1
210 IF Q1=1 THEN 250
220 IF Q1=0 THEN 230
230 LET I6=100
240 GOTO 330
250 PRINT "BELOW WHAT ELEVATION IN DEGREES DO YOU WANT PRINTOUT TO OCCUR";
260 INPUT I6
270 PRINT "WHAT ARE THE GMT MONTH,DAY,YEAR DESIRED";
280 FOR N=1 TO 25
290 INPUT F[N],V[N],Y[N]
300 IF F[N]=0 THEN 400
310 NEXT N
320 GOTO 280
330 PRINT "WHAT ARE THE GMT MONTH,DAY,YEAR,TIME INTERVAL(BEGINNING,"
340 PRINT "ENDING) DESIRED";
350 FOR N=1 TO 25
360 INPUT F[N],V[N],Y[N],Q[N],S[N]
370 IF F[N]=0 THEN 400
380 NEXT N
390 GOTO 350
400 LET N5=N-1
410 FOR N=1 TO N5
420 IF Q1=1 THEN 440
430 GOTO 470
440 LET E1=2400
450 LET B=0
460 GOTO 490
470 LET E1=S[N]
480 LET B=Q[N]
490 LET M=F[N]
500 LET D=V[N]
510 LET Y=Y[N]
520 LET Y1=Y-(INT(Y/100)*100)
530 PRINT
540 PRINT
550 IMAGE "POSITION OF THE MOON ON: ",2D,"/",2D,"/",4D
560 PRINT USING 550;M,D,Y

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570 PRINT
580 PRINT "GMT","AZ","EL","GHA","DEC"
590 PRINT "----","---","---","---","---"
600 PRINT
610 LET I1=2
620 REM:HERE BEGINS CALCULATION OF JULIAN DATE
630 IF M >= 3 THEN 710
640 IF INT((Y-1853)/4)<11 THEN 670
650 LET C1=-1
660 GOTO 680
670 LET C1=0
680 LET J1=365*(Y-1853)+D+30*(M+9)+INT((M+10)/2)
690 LET J2=INT((Y-1853)/4)+1+C1
700 GOTO 820
710 IF INT((Y-1852)/4)<11 THEN 740
720 LET C1=-1
730 GOTO 750
740 LET C1=0
750 IF M=9 THEN 790
760 IF M=11 THEN 790
770 LET C2=0
780 GOTO 800
790 LET C2=1
800 LET J1=365*(Y-1852)+D+30*(M-3)+INT((M-2)/2)
810 LET J2=INT((Y-1852)/4)+C1+C2
820 LET J=J1+J2
830 LET T1=J-17472.5
840 LET D9=(B-INT(B/100)*100)+INT(B/100)*60
850 LET D6=(E1-INT(E1/100)*100)+INT(E1/100)*60
860 LET D7=D9-D6
870 LET D8=D7-I
880 IF D7>0 THEN 900
890 GOTO 930
900 IF D8 >= 0 THEN 1860
910 LET B=E1
920 REM:CALCULATION OF LATITUDE AND LONGITUDE OF MOON
930 LET T=(B-INT(B/100)*100)/1440+INT(B/100)/24
940 LET T5=T1+T
950 LET K1=FNB(.751213+3.66011E-02*T5)
960 LET K2=FNB(.822513+3.62916E-02*T5)
970 LET K3=FNB(.995766+2.73778E-03*T5)
980 LET K4=FNB(.974271+3.38632E-02*T5)
990 LET K5=FNB(3.12525E-02+3.67482E-02*T5)
1000 LET L8=K1+.658*R5*SIN(2*K4)+6.289*R5*SIN(K2)
1010 LET L8=L8-1.274*R5*SIN(K2-2*K4)-.186*R5*SIN(K3)
1020 LET L8=L8+.214*R5*SIN(2*K2)-.114*R5*SIN(2*K5)
1030 LET L8=L8-.059*R5*SIN(2*K2-2*K4)-.057*R5*SIN(K2+K3-2*K4)
1040 LET K6=K5+.6593*R5*SIN(2*K4)+6.2303*R5*SIN(K2)-1.272*R5*SIN(K2-2*K4)
1050 LET L7=5.144*R5*SIN(K6)-.146*R5*SIN(K5-2*K4)
1060 REM:CALCULATION OF RIGHT ASCENSION (A=R1) AND DECLINATION(D1)
1070 LET D1=COS(L7)*SIN(L8)*.397821+SIN(L7)*.917463
1080 LET D1=ATN(D1/(SQR(1-D1^2)))
1090 LET G1=50.5+((D1)/(.792))*D5
1100 LET G2=80+((D1)/(.808))*D5
1110 LET G3=141.5-((D1)*(.738)*D5)
1120 LET G4=170.5-((D1)*(.857)*D5)
1130 LET A2=COS(L7)*COS(L8)/COS(D1)
1140 LET A1=(COS(L7)*SIN(L8)*.917463-SIN(L7)*.397821)/COS(D1)

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1150 LET A=ATN(A1/A2)
1160 GOSUB 1450
1170 LET P1=A
1180 LET L1=6.57098E-02*T1
1190 LET L=T*24*1.00274+6.64606+(L1-INT(L1/24)*24)
1200 LET L=(L-INT(L/24)*24)
1210 REM:CALCULATION OF GREENWICH HOUR ANGLE,G, FROM LOCAL SIDERAL TIME
1220 LET G=(L/24)*P5-R1
1230 IF G<P5 THEN 1260
1240 G=G-P5
1250 GOTO 1300
1260 IF G<0 THEN 1280
1270 GOTO 1300
1280 G=G+P5
1290 REM:CALCULATION OF YOUR LOCAL HOUR ANGLE,H, FROM GHA
1300 LET H=L6-G
1310 REM:CALCULATION OF ELEVATION,E, OF OBJECT
1320 LET E3=COS(L5)*COS(H)*COS(D1)+SIN(D1)*SIN(L5)
1330 LET E2=SQR(1-(E3*E3))
1340 LET E=ATN(E3/E2)
1350 IF E<0 THEN 1810
1360 IF E>I6*R5 THEN 1810
1370 REM:CALCULATION OF AZIMUTH,A, OF OBJECT
1380 LET A2=SIN(D1)/(COS(L5)*COS(E))
1390 LET A2=A2-(SIN(L5)/COS(L5))*(SIN(E)/COS(E))
1400 LET A1=SIN(L5)*SIN(D1)+COS(L5)*COS(D1)*COS(H)
1410 LET A1=(SIN(H)*COS(D1))/(SQR(1-A1^2))
1420 LET A=ATN(A1/A2)
1430 GOSUB 1450
1440 GOTO 1610
1450 REM:REMOVAL OF AMBIGUITIES INCURRED WITH ATN FUNCTION
1460 IF A=0 THEN 1480
1470 GOTO 1520
1480 IF A2<0 THEN 1500
1490 GOTO 1600
1500 LET A=P5/2
1510 GOTO 1600
1520 IF A>0 THEN 1580
1530 IF A2<0 THEN 1560
1540 LET A=P5+A
1550 GOTO 1600
1560 LET A=P5+(A-P5/2)
1570 GOTO 1600
1580 IF A2 >= 0 THEN 1600
1590 LET A=A+P5/2
1600 RETURN
1610 IF (T-I1)>(2*I)/1440 THEN 1630
1620 GOTO 1640
1630 PRINT
1640 IF FNA(D1)<0 THEN 1770
1650 IF FNA(G)<G1 THEN 1770
1660 IF FNA(G)>G2 THEN 1680
1670 GOTO 1710
1680 IF FNA(G)<G3 THEN 1730
1690 IF FNA(G)>G4 THEN 1770
1700 GOTO 1750
1710 LET S$="U"
1720 GOTO 1790

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1730 LET S$="W"
1740 GOTO 1790
1750 LET S$="J"
1760 GOTO 1790
1770 LET S$=" "
1780 IMAGE 4D10X,3D.D10X,2D.D11X,3D.D10X,3D.D,A
1790 PRINT USING 1780;INT(B+.5),FNA(A),FNA(E),FNA(G),FNA(D1),S$
1800 LET I1=T
1810 LET B=B+I
1820 LET Z=(B-INT(B/100)*100)-60
1830 IF Z<0 THEN 840
1840 LET B=INT(B/100)*100+100+Z
1850 GOTO 840
1860 NEXT N
1870 LET N=0
1880 PRINT
1890 PRINT
1900 PRINT
1910 PRINT "DO YOU WANT MORE INFORMATION(1=YES,0=NO)";
1920 INPUT Q2
1930 IF Q2=1 THEN 20
1940 IF Q2=0 THEN 1950
1950 END

```

POEME

WHAT ARE THE STATION CALL LETTERS?W6FO  
 WHAT IS YOUR LATITUDE IN DEGREES,MINUTES?37,34  
 WHAT IS YOUR LONGITUDE IN DEGREES,MINUTES?122,18  
 WHAT IS DESIRED PRINTING INCREMENT IN MINUTES?15  
 DO YOU ONLY WANT PRINTOUT WHEN THE MOON  
 IS NEAR THE HORIZON(1=YES,0=NO)?0  
 WHAT ARE THE GMT MONTH,DAY,YEAR,TIME INTERVAL(BEGINNING,  
 ENDING) DESIRED?12,13,1976,0000,2400  
 ?0,0,0,0,0

POSITION OF THE MOON ON:12/13/1976

GMT ---	AZ --	EL --	GHA ---	DEC ---
700	84.5	1.0	29.7	5.0
715	86.8	3.9	33.4	4.9
730	89.0	6.7	37.0	4.9
745	91.3	9.6	40.7	4.8
800	93.5	12.4	44.3	4.8
815	95.8	15.3	47.9	4.8
830	98.2	18.1	51.5	4.7
845	100.6	20.9	55.2	4.7
900	103.1	23.7	58.8	4.6U
915	105.7	26.4	62.4	4.6U
930	108.4	29.2	66.1	4.5U
945	111.2	31.8	69.7	4.5U
1000	114.2	34.5	73.3	4.4U
1015	117.3	37.0	76.9	4.4U
1030	120.7	39.5	80.6	4.4U
1045	124.3	41.9	84.2	4.3U
1100	128.1	44.2	87.9	4.3W
1115	132.2	46.3	91.5	4.2W
1130	136.6	48.3	95.1	4.2W
1145	141.4	50.2	98.7	4.1W
1200	146.5	51.8	102.3	4.1W
1215	152.0	53.3	106.0	4.0W
1230	157.8	54.5	109.6	4.0W
1245	164.0	55.4	113.3	4.0W
1300	170.3	56.0	116.9	3.9W
1315	176.8	56.3	120.5	3.9W
1330	183.3	56.2	124.1	3.8W
1345	189.6	55.8	127.7	3.7W
1400	196.0	55.1	131.4	3.7W
1415	202.0	54.2	135.0	3.7W
1430	207.6	52.9	138.6	3.6W
1445	213.1	51.4	142.2	3.6J
1500	218.2	49.7	145.9	3.5J
1515	222.8	47.8	149.5	3.5J
1530	227.2	45.7	153.2	3.5J
1545	231.2	43.5	156.8	3.4J
1600	234.9	41.2	160.4	3.3J
1615	238.4	38.7	164.0	3.3J
1630	241.7	36.2	167.6	3.3J
1645	244.7	33.6	171.2	3.2
1700	247.7	31.0	174.9	3.2
1715	250.4	28.3	178.5	3.1
1730	253.1	25.5	182.2	3.1
1745	255.6	22.7	185.8	3.1
1800	258.0	19.9	189.4	3.0
1815	260.3	17.0	193.0	2.9
1830	262.7	14.1	196.7	2.9
1845	264.9	11.3	200.3	2.8
1900	267.1	8.4	203.9	2.8
1915	269.3	5.4	207.5	2.8
1930	271.4	2.6	211.1	2.7

DO YOU WANT MORE INFORMATION(1=YES,0=NO)?0